The Mysore Coffee Experiment Station—Bulletin No. 14

DEPARTMENT OF AGRICULTURE

MYSORE STATE

IMPERIAL MYCOLOGICAL INSTITUTE
5 OCT 1936

ANNUAL REPORT OF THE COFFEE SCIENTIFIC OFFICER, 1935-36

BY

W. WILSON MAYNE, B.Sc.,
Scientific Officer to the United Planters' Association of Southern India

BANGALORE:
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FOREWORD.

As usual, this report is published as a Bulletin of the Coffee Experiment Station. It records further progress made in the investigation of Leaf Disease and Die-Back of coffee. Work on spray materials and methods seems to indicate the possibility of omitting an adhesive or spreader without in any way decreasing the efficiency of spraying itself. There are also definite indications that in certain localities, the pre-monsoon spray is fundamental and that the second spray is not quite essential.

B. Narasimha Iyengar,
Director of Agriculture.

ANNUAL ADMINISTRATION REPORT OF THE COFFEE SCIENTIFIC OFFICER—1935-36.

I have the honour to present the following report of work in progress during the year 1935-36, on problems connected with coffee. As usual the report contains an account of the investigations in progress and general notes on coffee problems which have arisen during the year.

Work has been centred at the Mysore Government Coffee Experiment Station as in previous years. Co-operative work with the officers of the Department of Agriculture has been continued in connection with breeding, spraying and miscellaneous problems.

The Assistant continued work at Sidapur, Coorg and though handicapped by much malaria, has made progress in the study of the eelworm problem, which will be discussed later in the report.

Early in the year a biochemist was appointed to undertake the chemical investigation into coffee quality, in accordance with the arrangement reached with the Mysore Agricultural Department. This officer on appointment was stationed at the U. P. A. S. I. Tea Experiment Station, Nellacotta for preliminary studies of technical methods elaborated there for the cognate problem in tea, and remained there until the end of the year.

The Coffee Scientific Officer's bungalow at Balehonnur Experiment Station was completed during the year.

Touring.

No touring was undertaken during the year except one visit to Coorg in connection with the work of the Assistant, and a week was occupied in accompanying Mr. S. Gillett, Agricultural Officer in charge of Coffee Investigations, Kenya Department of Agriculture, during his visit to representative estates in N. Mysore and the Bababudins.

Investigations.

Leaf Disease. Progress Report.—Work on Leaf Disease during the year falls into three sections :—

1. Continuation of the study of resistance and susceptibility of coffee strains.
2. The germination of the teleutospores.
3. The influence of plant nutrients on the development of infections.

1. Inheritance of Resistance to *Hemileia.* In this work continued progress has been made, but results have indicated an increase in the complexity of the problem. As has been previously been pointed out, progress in understanding the inheritance of disease resistance depends on the utilization in testing work of pure strains of the fungus. In view of the existence of distinct physiological strains of the fungus with different capacities for infecting different coffee varieties, considerable attention is necessary to obtain pure strains of the fungus. Up to the present year, two strains only of the disease had been isolated and used in testing work; Strain I capable of attacking Coorg coffee but unable to attack certain Kents and Strain II capable of attacking both Kents and Coorgs. A number of plants resistant to both these strains has been found and such plants appeared to show a complete resistance in the field. During the present year, several of these plants showed some infection in the field and these infections proved to be different from the two strains previously isolated, thus constituting a third distinct strain of *Hemileia vastatrix.* On the basis of certain indicator plants, these strains may be characterized as follows (Table I).

Table I. Strains of *Hemileia vastatrix.*

Indicator Plant ...	S. 5.	288·45	288·23	288·5
Strain—				
I ...	−	−	−	+
II ...	+	−	−	+
III ...	−	+	−	+

It may be remarked that S. 5. is a Kent type plant, while the other three plants are different members of a promising family of plants growing at the Station. The behaviour of 288·5 is similar to that of many, if not all old Coorg type plants at the Station.

In view of the time which has elapsed since the plants found susceptible to Strain III were planted and that previously these plants showed no disease, it seems likely that this strain is relatively uncommon. Plants susceptible to the other two strains usually show infection within a year of planting, whereas the plants susceptible to Strain III were noted as diseased only at the end of the third year from planting, although they have been under regular and thorough observation throughout their life.

This discovery obviously complicates the study of resistance to infection and the possibilities of purifying a disease free strain of coffee. There are, however, a large number of plants which appear to be of the type of 288·23. Further it appears that resistance to this third strain commonly occurs among Kents.

No work has yet been possible on the inheritance of resistance to the third strain, but progress has been made with respect to the inheritance of the two earlier discovered strains. The simple one factor inheritance of resistance to Strain I reported last year has been confirmed. Further evidence indicating that the inheritance of resistance to Strain II is governed by two factors, one of which is probably the same as that governing Strain I has been obtained.

If further work establishes firmly the comparatively simple inheritance of resistance to Strain II, there should be little difficulty in obtaining a strain of coffee resistant to both these strains, which would come true from seed.

2. *Teleutospore Germination.*—In view of the common occurrence of the teleutospore stage of *Hemileia vastatrix* on old infections during the dry season, it was thought advisable to study the possibilities of the infection of coffee leaves by the basidiospores produced from germinated teleutospores. Although numerous tests were made and all stages of the germination of the teleutospore, the formation of basidiospores and the germination of basidiospores were obtained, none of the attempts to produce infection of the coffee leaf gave any success.

3. *Influence of Plant Nutrients on Disease Development.*—Experiments were commenced during the year to investigate whether the rate of development of the fungus in the leaf could be influenced by various plant nutrients in solution, using the technique of inoculation of detached leaves previously described. So far, experiments have

been conducted with sucrose, potassium nitrate, calcium nitrate and potassium chloride. With the exception of the sucrose solutions, which were unsatisfactory under the conditions of the experiments, the mineral salts appeared to exert little effect, although potassium nitrate accelerated development somewhat. It seemed that the effect depended largely on the influence of the solutions on the health of the leaves, the healthier the leaves, the better the disease development. Further work on this problem is planned for the coming year. The intention is twofold: to find out whether it is possible to accelerate disease development for use in the study of disease resistance and susceptibility and also to see if any indications can be obtained of the possible effects of manures on disease development.

Die Back. Progress Report.—In continuation of the study of this disease a valuable opportunity of studying an attack of Die Back uncomplicated by the presence of Leaf Disease occurred during the year.

The results of this study fully supported the conclusions reached earlier that Die Back is primarily a secondary disease following unfavorable conditions and that some preceding defoliation is a predisposing factor. The case in question was that of a severe attack of Die Back in the second half of July on some coffee growing on a rather light stony soil. All stages of the death of shoots were available for study and it was clear that the point of the commencement of decay was almost in every case at the second or third node from the apex. In unaffected shoots it was frequently found that precisely these joints were leafless, though there were older leaves at older joints. An inspection of the leaf scars indicated that at these joints the leaves were predominantly the much dwarfed leaves characteristic of flush in dry weather; the leaf scars were much smaller than usual.

The ease with which a series of shoots could be collected from the apparently healthy shoots with leafless second and third nodes to shoots completely dead, with intermediate cases where the signs of decay were first noted at the second and third node indicated strongly the part played by partial defoliation.

The defoliation itself was probably caused by the extremely dry hot weather, the area in question receiving under one inch of rain in March, April and May.

Inspection of the roots revealed what appears to be

everywhere a common characteristic of Die Back attacks —the extensive dying of the finer rootlets.

The study of the fungi present showed the presence of the usual *Colletotrichum* together with several other common saprophytic fungi.

The evidence all pointed to a weak state of the trees at the beginning of the hot weather, a defoliation consequent on severe hot weather drought affecting mainly the young flush which expanded with the first shower and subsequently suffered a check and a death of fine roots probably attributable to the drying out of the upper layers of the very light soil. The Die Back was the consequence of these unfavorable growth conditions.

This case has been described in some detail as it is a very illuminating instance of Die Back unassociated with any other specific disease condition, and yet showing the same sequence of partial defoliation prior to the dying of the shoots.

Further studies of the distribution of the fungus on coffee shoots were made during the year. Attempts were made to isolate fungi from healthy green wood as well as from branches showing stages of Die Back. As usual, the isolations from the advancing edge of blackening tissue gave *Colletotrichum*, but in the case of green, healthy wood no fungi were obtained when the portions used were from internodes, while the nodal tissue even when apparently healthy frequently gave cultures of *Colletotrichum*.

Taking these results with those reported last year, it can be said that the fungus *Colletotrichum* occurs on the surface of quite healthy green coffee shoots, but is absent from the interior of the internodal tissue. The fungus may, however, occur in the tissues of the leaf scar without necessarily progressing further, even when the scar and surrounding tissue look quite normal. This evidence offers further support for the view that the part played by the fungus is secondary to the existence of other predisposing factors.

Work on Spray Materials and Methods.

Spray Mixtures.—The usual field observations in plots receiving different types of spray mixtures have been collected. The results are dealt with in the same groups as in 1934-35.

The first group records the results obtained for the materials which have been under continuous study since 1930-31. These are Casein Bordeaux, Resin Soda Bordeaux, Linseed Oil (10 oz.) Bordeaux, plain Bordeaux and Fish Oil Resin Soap Burgundy. The results of the leaf amount index and the percentage infection are given in Table II. As in previous years, there are no definite differences between these treatments and the results agree with such evidence as is provided by the yield data.

TABLE II.

Leaf Amount Index and Percentage Infection for Different Spray Mixtures in use since 1930-31.

Spray Mixture	Leaf Amount Index	Percentage Infection
Plain Bordeaux	6·75	26·7 per cent
Fish Oil Soap Burgundy	6·61	26·0 do
Resin Bordeaux	6·61	32·3 do
Linseed Oil Bordeaux	6·42	33·3 do
Casein Bordeaux	6·28	24·1 do
Control	4·76	71·9 do

The results for the new mixtures introduced during the past two or three years are given in Table III. Of the sprays tested last year, Sodium Linoleate Bordeaux and Sulphemulsol were dropped, the former to make room for a trial of Molasses Bordeaux and the latter on account of its complete lack of effectiveness.

TABLE III.

Leaf Amount Index and Percentage Infection for Different Spray Mixtures in use during past two years.

Spray Mixture	Leaf Amount Index	Percentage Infection
Jingelly Oil Bordeaux (40 ozs.) ...	6·92	29·0 per cent
Do (80 ozs.) ...	6·80	33·9 do
Groundnut Oil Bord. (80 ozs.) ...	6·39	31·4 do
Molasses Bordeaux	6·33	42·0 do
Honge Oil Bordeaux (20 ozs.) ...	6·77	33·3 do
Groundnut Oil Bord. (20 ozs.) ...	6·28	34·7 do
Jingelly Oil Bord. (20 ozs.) ...	6·02	33·1 do

The data as usual in this experiment are rather featureless. Molasses Bordeaux shows a slightly increased percentage of infection compared with the remainder, but otherwise no satisfactory evidence of the superiority of any of these additions to the spray has been obtained.

It seems that the omission of an adhesive or spreader from the spray when used against Leaf Disease is quite a safe economy to make.

Spray and Dusts.—A further series of tests on the relative merits of Bordeaux spraying and the use of a copper containing dust were undertaken in co-operation with an estate in Coorg. The results of the observations of the usual type undertaken by the Assistant were less definite than last year. There were three sets of three plots, comprising one plot sprayed, one dusted and one untreated. The results are given in Table IV.

TABLE IV.

Leaf Amount Index and Percentage Infection for Spray and Dust Treatments.

	Series 1		Series 2		Series 3	
Sprayed ...	6·11	71·3%	4·91	68·9%	5·61	63·6%
Dusted ...	6·21	71·3%	4·98	63·2%	5·32	71·5%
Control ...	5·70	71·4%	3·52	64·3%	4·15	59·3%

The control obtained with both treatments was poor and no definite difference between them is apparent. Both treatments show a small gain over the control plots, though it is small compared with the gains noted in work at the Station.

In view of the relatively poor control obtained with either treatment, as indicated by the very high percentage infection, it would be unwise to draw any very definite conclusion from this experiment. It may be that the disease was well established before the treatments were carried out and that differential effects were therefore reduced.

Time and Strength of Spray.—The observations bearing on the time of application and the strength of the spray have been continued as in previous years. They

are now continued primarily for the study of the variation in disease intensity and degree of control of the disease in relation to climatic variations, and also to see whether any clearer light can be thrown on the part played by the September spray. The results this year resemble in all essentials those of previous years, as can be seen from Table V.

TABLE V.

Leaf Amount Index and Percentage Infection of Time and Strength of Spray Experiments.

Treatment	Sept.—Oct. 1935		Feb.—Mar. 1936	
	Leaf	% Inf.	Leaf	% Inf.
		Per cent		Per cent
Control 1	2·02	50·7	2·77	17·0
1% May and Sept. ...	5·01	33·8	3·45	27·5
Control 2 ...	2·82	42·0	2·91	21·8
1% May only ...	6·77	31·9	2·79	28·8
Control 3 ...	2·90	47·9	2·27	23·7
½% May and Sept. ...	7·93	44·2	3·54	36·0
Control 4 ...	4·56	60·5	2·35	29·9
½% May only ...	7·97	22·0	1·87	42·3
Control 5 ...	4·49	58·3	2·60	21·5
1% Sept. only ...	3·58	35·4	3·33	14·4
Control 6 ...	2·96	32·0	2·49	9·4
½% Sept. only ...	4·83	54·1	3·43	17·8
Control 7 ...	2·81	58·4	2·70	21·5

On the whole the indications are of a relatively light disease attack in agreement with the expectations from general inspection. There are, however, considerable variations in the various controls showing a much greater falling off from the fourth and fifth controls than usual, although such a tendency has been noticeable during the last three years of the observations. It may be remarked that a generally similar course of the yields of these plots is also noticeable. It is difficult to account for these variations, which cannot be attributable to defects in the observational method as they are frequently obvious to the eye over the whole plots.

One striking feature in the present results is the marked improvement in the plots sprayed twice compared

with those sprayed in May only, at the February observation. The gain from the second spray is higher than it has ever been in these observations.

As far as the results with respect to the strength of spray are concerned, there is no difference in effectiveness to be noted between the two strengths used. After due allowance is made for the severe disease situation in the neighbourhood of the one per cent twice sprayed plot as indicated by the neighbouring controls the net gain from spraying over the controls is approximately the same as in the ½ strength (0·5 per cent) sprayed plot.

With respect to the time of spraying it is clear that in this area the pre-monsoon spray is fundamental and the second spray quite secondary in importance.

The results of this experiment for the past five years have been utilized in a recently prepared paper.

Studies of Fruit Setting and Fruit Development.

Crop Losses during Development.—Observations of the usual type were carried out during the year—the fifth year of this investigation. The results differ considerably from previous years, the data for which will be found in the 1934-35 report. Analysing the data for the past year in the same way as in the last years' report, the figures given in Table VI are obtained.

TABLE VI.

Distribution of Loss of Young Fruit. 1935.

Losses	1932	1934	1935
	Per cent	Per cent	Per cent
Loss up to and including visible size difference	31·2	37·3	18·0
Unswollen fruit persisting ...	14·5	10·2	9·5
Loss 6 weeks following size differentiation	11·4	20·0	6·4
Later loss	1·4	1·9	6·7
			1·5
Total ...	58·5	69·4	42·1
Flower bud present at beginning ...	5,379	5,310	3,054

The striking feature of this year's data is the high percentage of flower buds which set fruit; whereas the highest percentage set in any previous year was 41·4 per cent (1932), in this year it has risen to 57·9 per cent. This result is all the more surprising in that the short hot weather rains which appeared to exert such an unfavourable influence on fruit setting in 1934 were again experienced in 1935.

In two ways the distribution of loss and the time of fruit development resembled the 1934 data; the date of visible differentiation of potentially good fruit from those which did not develop further was as late as in 1934 and the time of loss of partially developed fruit was also late and in fact later than in 1934. This loss was so late that the conventional grouping of the loss in the six weeks following differentiation of fruit size did not suffice to cover the total loss of partially developed fruit. In view of this, the loss later than six weeks after the second group of losses was divided into two sections, the first being the loss in the first month of this period and the second being the loss in the remaining 3 months before harvest.

On examining the data in comparison with 1932 and 1934 the most striking feature is the reduction of the first loss immediately following the blossom and this accounts for nearly all the difference between the losses in 1932 and in the present year. It suggests that the great improvement in setting in 1935 must be mainly attributable to a reduction in the loss immediately after blossoming. A detailed study of the data is in progress which, it is hoped, may throw some light on the variations from year to year found in these data.

From the data already published in reports it can be seen that :—

(1) Fruit setting is variable in different years in the same locality.

(2) The setting is subject to three clearly defined periods of loss.

(3) The losses of developing fruit in the later stages of development are very small when diseases affecting the leaves and shoots are controlled.

(4) The variations in setting appear as a rule to be due to variations in one or other of the three main loss groups rather than to be distributed over all the groups.

It is interesting to note that with only 60 per cent of the number of flower buds present in 1934, the same number of branches in 1935 matured about six per cent more fruit. This will serve to indicate how important setting can be.

The Fruit Picked.—As in previous years the fruit picked from the branches under observation were cut open and examined for fruit abnormalities. The data are given under the same headings as in the previous years in Table VII.

TABLE VII.

Analysis of Fruit Picked.

	1932	1934	1935
Total Fruit	2,226	1,608	1,746
Per cent Peaberry	21·5%	12·1%	22·6%
Per cent 3 bean fruit	1·0%	0·3%	0·3%
Total Beans	4,001	2,984	3,100
Per cent empty beans	2·3%	2·3%	3·4%
Per cent black beans	0·3%	6·8%	0·4%

The figures call for little remark. There is a slight increase in the amount of empty beans (jelloo) compared with the four previous years' records. Black bean was negligible, only 13 beans showing any signs of this type of defect and five of these were strictly only spotted beans. Only six polyembryonic beans were found in the 3,100 beans examined.

If the leaf fall in August is at all associated with the incidence of Black Bean, as was suggested by the results reported last year, the expectation during the present year was realized in that leaf fall during August was very slight during that month in 1935.

Effects of Defoliation on Fruit Development.—In view of the suspicion of a relation between leaf loss and the incidence of Black Bean, an experiment was instituted to investigate whether Black Bean could be produced by defoliation. During August a group of heavy bearing trees were selected and at weekly intervals from August 1st, four trees were partially defoliated by removing all but the first two pairs of leaves from every shoot. At

harvest the trees were harvested separately and the lights separated and examined. The results of this experiment are given in Table VIII.

TABLE VIII.

The Analysis of Lights from Defoliation Experiment.

Date of defoliation	Type	Tree 1	Tree 2	Tree 3	Tree 4
1st Aug. 1935 ...	(*a*) Black Beans ...	2·67	2·12	0·74	2·67
	(*b*) Total Light ...	13·3	27·8	24·4	33·1
8th Aug. ,, ...	(*a*) Black Beans ...	2·80	0·57	3·33	1·33
	(*b*) Total Light ..	25·8	29·1	35·0	28·0
16th Aug. ,, ...	(*a*) Black Beans ...	6·56	4·00	2·83	1·17
	(*b*) Total Light ...	15·0	55·0	50·5	16·5
28th Aug. ,, ...	(*a*) Black Beans ...	3·39	10·0	8·67	1·20
	(*b*) Total Light ...	30·3	203·8	36·3	25·0
Control ...	(*a*) Black Beans ...	1·05	0·50	2·00	1·71
	(*b*) Total Light ...	28·0	30·3	26·9	30·0

In the table the number of affected fruit is given per lb. of fresh cherry picked No very clear conclusions can be drawn from this, as the amount of Black Bean was very small throughout and the agreement between the trees within each treatment is not very good. Similar remarks apply to the amount of jelloo. Furthermore, the two series showing the higher amounts of light and black bean gave slightly higher yields per plant. However, there does seem to be a tendency to higher amounts of Black Bean in the plants defoliated in the second half of the month, 4 out of the 8 trees giving markedly higher amounts of such beans.

While no conclusions can be drawn as yet, the matter deserves further following up in the coming year.

Laboratory Work on Fruit Development and Abnormalities.—During the year a quantity of material has been fixed and embedded for sectioning to study the development of the fruit. Although the development and fertilization of the flower and the anatomy of the ripe bean have been studied, little is known of the details of fruit

development between fertilization and maturity. So far only a very little of this material has been studied and it would be premature to discuss the fragmentary data so far obtained.

An interesting botanical point is the finding of a case of true polyembryony as distinct from the usual false polyembryony in the dissection of some partially developed beans. In the case found, two embryos were found in one endosperm, whereas the usual polyembryony in coffee consists of two embryos plus two endosperms in one parchment loculus.

A number of specimens of defective beans have been received during the year and while it has been impossible to ascribe any definite causes to these defects, it has become clear that a large proportion of defects can be ascribed to abnormalities in the cell layer immediately underlying the silver skin. It seems probable that the important defect known as coating is due to variations in this layer. It is hoped that the studies in progress on fruit development may throw more light on the origin and fate of this tissue.

Studies on Coffee Preparation.

Fermentation.—Owing to the fact that the Experiment Station coffee was not pulped during the past season, little progress was possible in the study of fermentation organisms. A considerable amount of attention was paid, however, to the laboratory study of fermentation under water. A technique was devised which permitted of rough estimates being made of the degree of removal of the 'Saccharine layer' after definite intervals of time and this was used to study the speed of the process. Under the conditions of the experiments carried out, fermentation under water was always slower than when done in the ordinary way. The beans cleaned by under water fermentation gave a cleaner parchment than those cleaned in the ordinary way and there was a considerable reduction in the yeasts associated with the fermentation, though a film of yeasts appeared on the water surface.

An attempt to study the effect of using a flow of water as recommended by the Java workers was unsuccessful and could not be repeated owing to the early completion of crop harvest. In an effort to continue the study, an attempt was made to get supplies of coffee from other

estates but as this frequently meant keeping the fruit in the cherry for 24 hours, further work was not possible. It was found that keeping the cherry for 24 hours resulted in a rapid completion of fermentation by either method and moreover, simple agitation was sufficient in such cases to remove a substantial portion of the 'saccharine layer' without any further fermentation.

From some estate results which have been noted, it seems likely that the aeration of the water used is an important factor in success by the under water method.

Studies of fermentation under sterile conditions in the laboratory suggested that in water of a pH of about 6·5, fermentation in the absence of organisms is negligible. While cleanliness of the vats is desirable, it does not seem that any attempt at partial sterilization of the vats is necessary.

Work on Nematode Worms and the Establishment of Supplies.

This work is being conducted by the Assistant and while progress has been made, interruptions on account of ill health have occurred. The work falls into the same two sections as last year, (1) the study of the Nematodes and their fluctuations in the soil and, (2) the possibilities of manuring and other cultural treatments in avoiding the damage caused by them.

1. The Study of the Nematodes. This work has fallen into two main divisions, a detailed study of the Nematode types found in the soils of affected areas and the further study of the inoculations of healthy plants.

Following on the work on the soil population of the Nematodes in the dry weather reported last year, the examination of the soil population was continued into the monsoon. It was found that with the onset of the monsoon rains an extremely rapid increase of nematodes occurred in the soil, including both known parasitic types and others. Attention was focussed on one type in particular whose presence appeared always to coincide with failures of supplies, though it has not been found in the adult form in plant tissues. It was noted that at first this type was mainly represented by larval stages, which gradually diminished in number in July and August with an increase in the number of adults.

It became increasingly clear that further progress

demanded a study of the constituents of the eelworm fauna in the soil in relation to success and failure of young plants. In the course of numerous examinations of of soils and sickly plants, 11 main types of worms have been found and these have all been carefully studied. Of these, one is commonly parasitic on Dadap roots but does not appear to attack coffee. This is *Caconema marioni* which is well known as a parasite of a number of agriculturally valuable plants. Four species have been found under conditions which mark them as definite parasites of coffee roots. Two of these have been identified as *Anguillulina pratensis* and *A. robusta* while the remaining two are as yet unidentified. With the exception of one species, the remainder are almost certainly secondary invaders of decaying tissue. The one species whose importance remains uncertain is characteristic of areas where supply failure is high, but has not so far been encountered actually in coffee tissues. There are a number of points with respect to this species which requires closer investigation, as its presence in such large numbers in soils where supply failure is high, suggests some relationship between them. So far it has not been possible to find young stages of this worm in the soil, all the specimens consisting of late stage larvae and adults.

Throughout this work it has been found that where roots are infected by one or other of the parasitic types, that particular type is always the dominant, and sometimes the only worm present. Moreover, such worms are practically always localized just ahead of the decayed tissues.

During the year a successful technique for infecting rootlets with the worms has been devised and this is being used to study the mode of infection in more detail than has hitherto been possible. Further work is now in progress by this technique and it is hoped that the results will be of value in understanding how and when the attack of the roots is initiated.

Manuring of Supplies.—The work reported last year on this question was continued and the results are contained in the attached table.

TABLE IX.

Elect of Manuring on Establishment of Supplies.

Manure	Expt. 1	Expt. 2	Expt. 3	Expt. 4
Nitrogen	10·6± 6	8·6±·8	8·7±·5	*15·1±1·1*
Phos. Acid	*13·6±·7	9·5±·6	8·8±·6	*13·1±1·1*
Potash ...	*8·8±·7*	*5·6±·6*	9·1±1·0	10·1±·8
NP	14·2±1·1	9·6±·6	8·7±·8	*15·8±·9*
NPK	10·9±·9	8·3±·9	*6·3±·5*	*13·9±·7*
Control	12·2±·7	8·6±·7	8·8±·6	8·5±·5

* This plot received an estate mixture and not Phosphoric Acid alone.
Italicized figures show a definite increase or decrease over control.

The figures given in the Table IX are the mean height increase in the nine months following planting. The first three experiments were in one estate known to be eelworm infected, while the fourth was conducted in an area not seriously affected. It can be seen that in this experiment series, there was no definite gain from the manure applied in the first three experiments, though the depressing effect of Potash appeared in two out of the three series, thus bearing out the results last year. In the fourth series definite gains were obtained with Nitrogen alone, Phosphoric Acid alone, Nitrogen and Phosphoric Acid and the complete mixture, though the complete mixture was not as satisfactory as the applications without Potash.

The data for the number of primaries formed and the number of leaves per plant show the same trends as the data given for height increase.

These results unfortunately do not suggest that manuring is likely to assist plants greatly in eelworm infested areas. The gains in the experiment conducted in non-eelworm infested land are very markedly greater than any gains in the eelworm infested lands where there is, in fact, no single case of a definite improvement in growth from the application of manure. It is true that the first three experiments are not strictly comparable with the fourth as the latter was planted and manured in July and the three former in September, but the fact remains that the response to manure given at planting has been negligible in the case of the first three experiments.

Planting Time and Plant Survival.—In an effort to see how planting time and type of plantused affected survival, a large number of plants were kept under observation. A portion of them were root plants, planted in July 1934 and the remainder ball plants planted in September. The survival rate up to the end of May 1935 showed 91·9 per cent of the ball plants healthy as compared with only 73·3 per cent of the root plants. Moreover, in approximately the same time from planting, the ball plants had shown nearly double the growth shown by the root plants.

It is interesting to note that the root plants were planted at a time when soil examinations showed a marked increase in the eelworm population. It seems fairly evident that planting in eelworm infested areas should be avoided in the early monsoon and planting methods employed which minimize the damaging of the finer roots in transplanting.

Manuring Experiment on Mature Coffee.—A co-operative manuring trial on different forms of Phosphoric Acid has been harvested for the past two years by the Assistant. The experiment was laid out as a Latin Square of 16 plots each of 81 trees, there being four plots to each treatment. The mixtures used were composed of Sulphate of Ammonia and Muriate of Potash and Phosphoric Acid was supplied as Bone meal, Superphosphate and Preciphos while the control plots were unmanured. The manures were applied in the hot weather following the showers in 1933, 1934 and 1935 and yields are available for 1934-35 and 1935-36. The total yields for each treatment are given in pounds of Cherry per plot in Table X. The Bone meal plots have given in the lowest yields but none of the differences can be considered significant.

TABLE X.

Yields in lbs. ripe Cherry per Plot in Mature Coffee Manuring Expt.

Treatment	1934–35	1935–36
	lbs.	lbs.
Control ...	258	152
N, K + Bone Meal ...	249	123
N, K + Preciphos ...	272	169
N, K + Superphospate ...	263	140

It may be that the earlier history of manuring on the estate may interfere with results and that residual effects may be responsible for the lack of difference between the controls and treated plots.

It is of interest to note that there is a significant negative correlation between the yields of the 16 plots in the two years, irrespective of the treatment, *i.e.*, the plots yielding highest in 1934-35 yielded lowest in 1935-36, and *vice versa*.

Tar Distillate Tests for Borer Control.—In co-operation with the Mysore Government Entomologist a small test of Tar Distillate as a means of reducing borer losses was undertaken in Coorg. The number of trees treated was unfortunately too small for very definite results, as the removals from the control as well as the treated area were very small. However, of 582 treated plants, 10 were attacked by borer, three of which were attacked in the upper part of the tree above the Tar Distillate application, while out of 382 trees constituting the untreated control 12 trees were attacked and removed.

During the present year, this experiment has been repeated on a more extensive scale and in addition, arrangements were made to assist in trials with an imported tar oil wash.

General Notes.

The Year 1935-36.—The following general notes are based primarily on the experience at the Experiment Station supplemented by occasional reports from elsewhere. They cannot be considered as at all generally applicable but may be of interest.

The striking feature of the year locally was the extremely dry hot weather, the rainfall for April and May only reaching a little over 3 inches. This dry hot weather followed a long drought. In spite of the dry hot weather, blossom showers were better than in 1934 and on the whole crops set better than in the previous year.

The effect of the long drought and the dry hot weather was to check the early development of Leaf Disease and on the whole at the Experiment Station the disease attack was light. Growth was good but the amount of shoot was rather on the small side. It has become clear that a distinction must be made between the number of shoots produced and the length attained by

such shoots as are produced. The former is subject to much greater variation than the latter, from year to year. In the present year, the amount of shoot produced was not high and although the hot weather growth of this shoot was also small it was largely made up in the monsoon. As a result, the September spray showed bigger gains than usual towards the end of the year.

As was to be expected from the conditions in 1934-35—poor amount of shoot as a result of the hot weather dryness and severe late disease, the crop at the Station was small.

The Station escaped early rain in 1936, though it was experienced fairly generally in the district and the prospects for the coming year are good. Blossom showers fell in the third week of March and were heavy.

Fungus Diseases.—No new leaf or shoot diseases came under observation during the year, but several specimens have been received of dead nursery seedlings and young plants in their first and second year. No extensive investigation of these diseases was undertaken owing to lack of time. In one case, a species of *Fusarium* was obtained in culture and an attempt was made to carry out inoculations on potted plants but no result was obtained. Most of these diseases were obviously infections of the collar region and probably are to be traced to excessive crowding and high humidities in the nursery. The young plants in their first and second year were also suffering from a collar disease. It is a sound sanitary practice to dip all young plants in a Bordeaux mixture before planting out and this should reduce the risk of such collar diseases.

An interesting case of copper poisoning due to the spilling of Copper Sulphate near the roots of Robusta plants was reported. One striking feature of this poisoning was the marked effect of the copper in causing an abnormal elongation and separation of the cells of the cork layers, resulting in the development of considerable areas of swollen spongy bark just above ground level. Copper was readily detected in the outer wood tissues.

Several cases of physiological abnormalities of the fruit were received. These were examined and found to be mainly traceable to abnormalities in the silver skin region of the bean. These have already been commented upon in an earlier section.

Some cases of a marked chlorosis of coffee were reported and an attempt to study the possibilities of

correction by placing petioles of affected leaves in various solutions was made. No results were obtained from dilute solutions of Ferrous Sulphate, Copper Sulphate, or Potassium Nitrate.

Insect Pests —The long drought and dry hot weather resulted in considerable activity of sucking bugs and reports indicate that during the last couple of years Green bug has been on the increase. The use of Honge Oil Resin Soap has extended and been found, in the main, satisfactory. Requests are frequently made with respect to the possibilities of a combined spray for both green bug and fungus diseases of the leaf. Tests have been made of several insecticides with this end in view. In the hot weather of 1935, laboratory tests on infested shoots were made with a mineral oil which emulsified with water and with Nicotine Sulphate. Neither of these proved as effective as Honge Oil Resin Soap ; the mineral oil, which was not specially designed for insecticidal work was partially effective but liable to damage the leaves.

In the hot weather of 1936, work was started with three proprietary mineral oil emulsions and one of these shows some promise. The work was still in progress at the end of the year. The mineral oil emulsion showing promise is miscible with Bordeaux but work still remains to be done on the influence of the mixing on the properties of both the insecticide and the fungicide.

An interesting case of damage by Cockchafer grubs was received and it was quite clear from these specimens that the damage caused by Cockchafers to young plants is quite different from the symptoms which were at one time attributed to these grubs in South Coorg. The whole tap root was completely stripped of cortical tissue and no side roots were present at all. The source of the grubs was undoubtedly the cattle manure used in filling the baskets.

As was anticipated last year, the current year was a severe for one for borer. Work on the control of this pest has already been noted.

The outbreak of thrips reported last year has not been again reported.

Correspondence, Publications.

There has been a distinct falling off of enquiries during the year, only 156 letters of enquiry with respect to coffee problems having been received.

No new bulletins were published during the year, but an account of recent work on spraying times and the relation of climate to Leaf Disease attacks was in preparation at the end of the year. Two short notes were published in "The Planters' Chronicle"—"A Spray Warning," which subsequent events in some areas at least, proved to be justified, and "Copper Containing Sprays and the Absorption of Copper in the Soil," being a review of a paper dealing with this subject emanating from Switzerland.

A report on one estate visit was submitted to the estate concerned.

Acknowledgments.—It is once more a pleasure to express my appreciation of the cordial co-operation and assistance that I have received from the Director and members of Staff of the Mysore Department of Agriculture throughout the year. I also gladly express my thanks to the many planters who at various times have assisted me with hospitality, suggestions and in co-operative experiments.

I should like at this point to ask that planters would as far as possible keep me informed of any abnormal disease situation or other circumstance of interest with respect to the growth and productivity of coffee. This applies especially to such questions as incidence of Die Back, Leaf Disease and Black Bean. On the last problem estate reports from year to year, together with any relevant information on climate, blossom showers and attacks of other diseases are greatly needed.

Mr. Subramanyam has worked well but the health conditions at Sidapur are distinctly bad and progress has been slowed down in consequence.

W. WILSON MAYNE,

Coffee Scientific Officer,

U. P. A. S. I.

12*th May* 1936.

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